

MRF35002N6T1 replaced by MRF35002N6AT1.

# Gallium Arsenide PHEMT

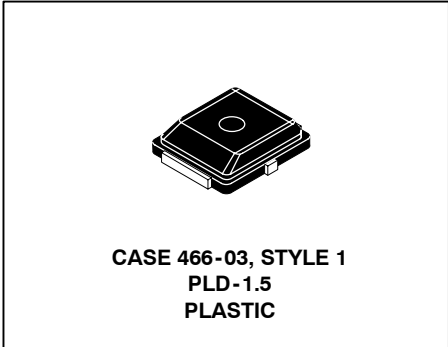
## RF Power Field Effect Transistor

Designed for WLL/MMDS/BWA or UMTS driver applications. Characterized from 500 to 5000 MHz. Device is unmatched and is suitable for use in Class AB Customer Premise Equipment (CPE) applications.

- Typical Single-Carrier W-CDMA Performance:  $V_{DD} = 6$  Volts,  $I_{DQ} = 65$  mA,  $P_{out} = 158.5$  mWatts Avg., 3550 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.  
 Power Gain — 10 dB  
 Drain Efficiency — 27%  
 ACPR @ 5 MHz Offset — -41 dBc in 3.84 MHz Channel Bandwidth
- 1.5 Watts P1dB @ 3550 MHz, CW
- Excellent Phase Linearity and Group Delay Characteristics
- High Gain, High Efficiency and High Linearity
- RoHS Compliant.
- In Tape and Reel. T1 Suffix = 1000 Units per 12 mm, 7 inch Reel.

**MRF35002N6T1**

**3.5 GHz, 1.5 W, 6 V**  
**POWER FET**  
**GaAs PHEMT**



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**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	8	Vdc
Gate-Source Voltage	$V_{GS}$	-5	Vdc
RF Input Power	$P_{in}$	22	dBm
Storage Temperature Range	$T_{stg}$	-65 to +150	°C
Channel Temperature (1)	$T_{ch}$	175	°C
Operating Case Temperature Range	$T_C$	-20 to +85	°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (2)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	15.2	°C/W

**Table 3. Moisture Sensitivity Level**

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	1	260	°C

1. For reliable operation, the operating channel temperature should not exceed 150°C.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rt>. Select Documentation/Application Notes - AN1955.

**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

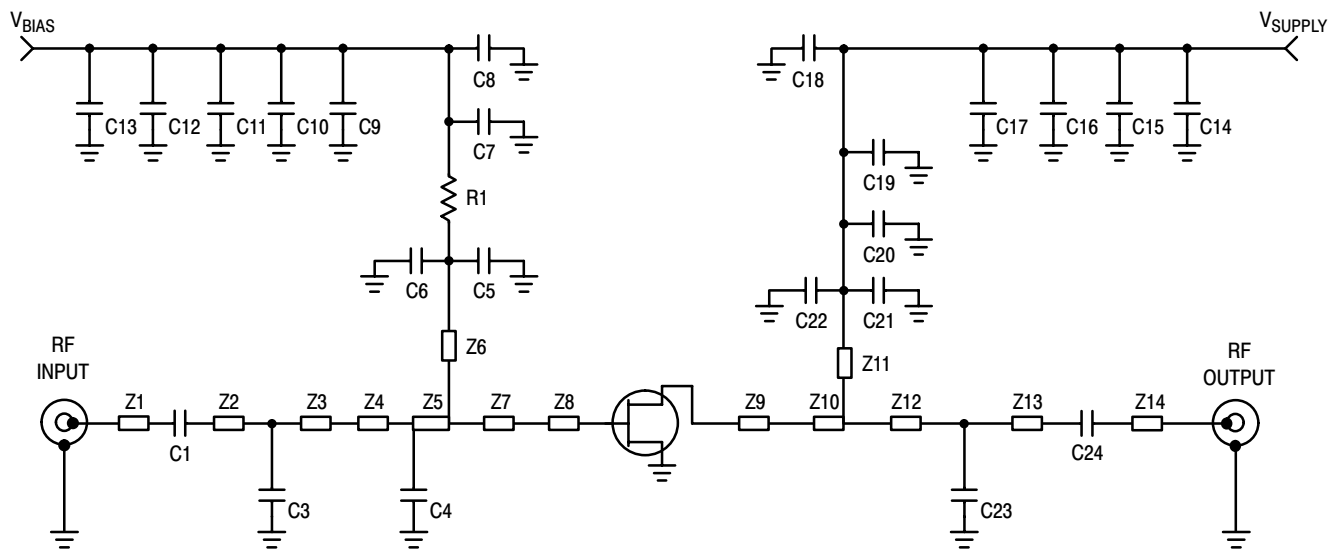
Characteristic	Symbol	Min	Typ	Max	Unit
Saturated Drain Current ( $V_{DS} = 3.5\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	1.7	—	Adc
Off State Leakage Current ( $V_{GS} = -0.4\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	< 1.0	100	$\mu\text{Adc}$
Off State Drain Current ( $V_{DS} = 6\text{ Vdc}$ , $V_{GS} = -2.5\text{ Vdc}$ )	$I_{DSO}$	—	—	600	$\mu\text{Adc}$
Off State Current ( $V_{DS} = 28.5\text{ Vdc}$ , $V_{GS} = -2.5\text{ Vdc}$ )	$I_{DSX}$	—	< 1.0	9	mAdc
Gate - Source Cut-off Voltage ( $V_{DS} = 3.5\text{ Vdc}$ , $I_{DS} = 8.7\text{ mA}$ )	$V_{GS(th)}$	-1.2	-0.9	-0.7	Vdc
Quiescent Gate Voltage ( $V_{DS} = 6\text{ Vdc}$ , $I_D = 65\text{ mA}$ )	$V_{GS(Q)}$	-1.1	-0.8	-0.6	Vdc

**Functional Tests** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 6\text{ Vdc}$ ,  $I_{DQ} = 65\text{ mA}$ ,  $P_{out} = 158.5\text{ mW Avg.}$ ,  $f = 3550\text{ MHz}$ , Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain	$G_{ps}$	8.5	10	—	dB
Drain Efficiency	$\eta_D$	23	27	—	%
Adjacent Channel Power Ratio	ACPR	—	-41	-38	dBc

**Typical RF Performance** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 6\text{ Vdc}$ ,  $I_{DQ} = 65\text{ mA}$ ,  $f = 3550\text{ MHz}$

Output Power, 1 dB Compression Point, CW	$P_{1dB}$	—	1.5	—	W
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Z1, Z14	0.044" x 0.125" Microstrip	Z8	0.420" x 0.150" Microstrip
Z2	0.044" x 0.500" Microstrip	Z9	0.150" x 0.068" Microstrip
Z3	0.044" x 0.052" Microstrip	Z10	0.290" x 0.183" Microstrip
Z4	0.468" x 0.010" Microstrip	Z12	0.044" x 0.115" Microstrip
Z5	0.468" x 0.356" Microstrip	Z13	0.044" x 0.894" Microstrip
Z6, Z11	0.015" x 0.549" Microstrip	PCB	Rogers 4350, 0.020", $\epsilon_r = 3.5$
Z7	0.031" x 0.259" Microstrip		

Figure 1. MRFG35002N6 Test Circuit Schematic

Table 5. MRFG35002N6 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C24	13 pF Chip Capacitors	100A130JP150X	ATC
C2	Not Used		
C3	1.2 pF Chip Capacitor	08051J1R2BBT	AVX
C4	0.7 pF Chip Capacitor	08051J0R7BBT	AVX
C5, C6, C21, C22	5.6 pF Chip Capacitors	08051J6R8BBT	AVX
C7, C20	10 pF Chip Capacitors	100A100JP150X	ATC
C8, C19	100 pF Chip Capacitors	100A101JP150X	ATC
C9, C18	100 pF Chip Capacitors	100B101JP500X	ATC
C10, C17	1000 pF Chip Capacitors	100B102JP50X	ATC
C11, C16	0.1 $\mu$ F Chip Capacitors	CDR33BX104AKWS	Kemet
C12, C15	39K pF Chip Capacitors	200B393KP50X	ATC
C13, C14	10 $\mu$ F Chip Capacitors	GRM55DR61H106KA88B	Kemet
C23	0.2 pF Chip Capacitor	08051J0R2BBT	AVX
R1	100 $\Omega$ , 1/4 W Chip Resistor		

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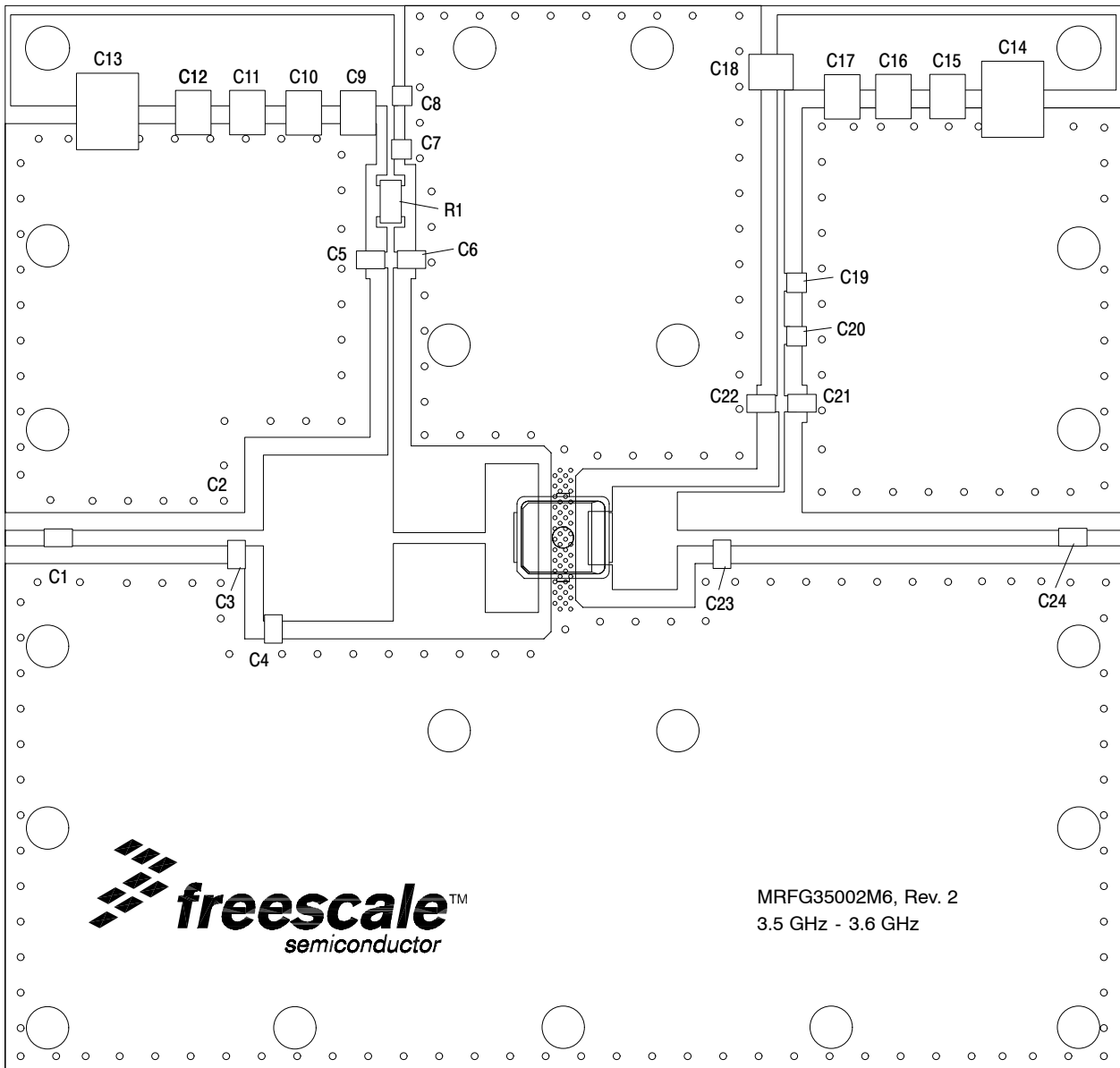
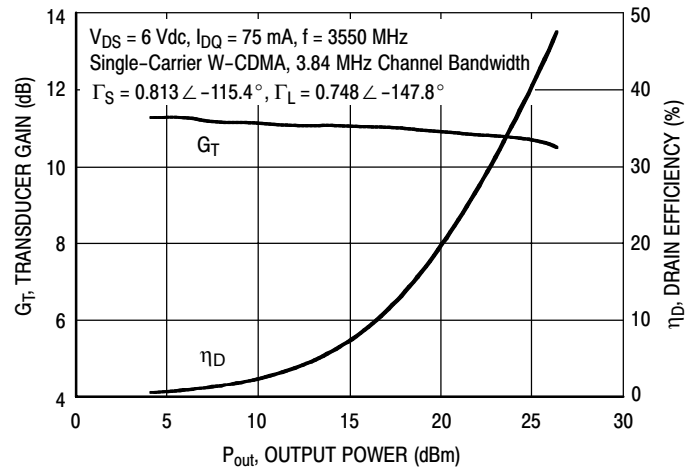
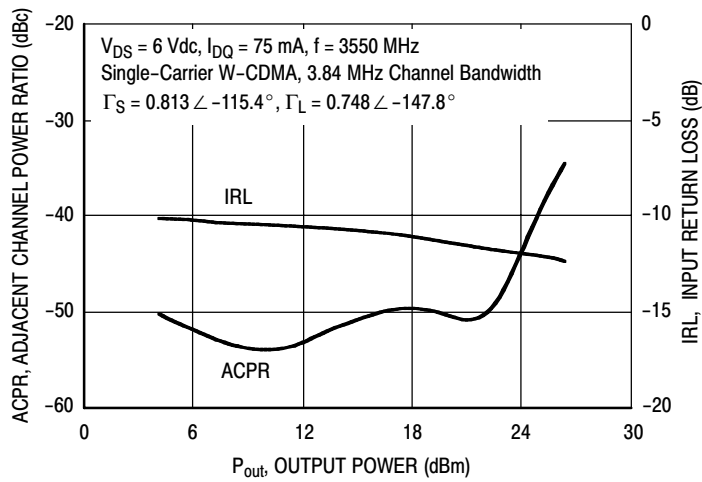


Figure 2. MRFG35002N6 Test Circuit Component Layout

### TYPICAL CHARACTERISTICS



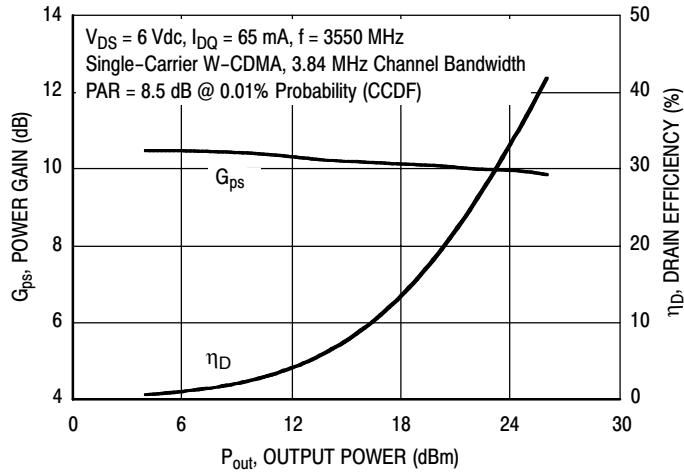
**Figure 3. Transducer Gain and Drain Efficiency versus Output Power**



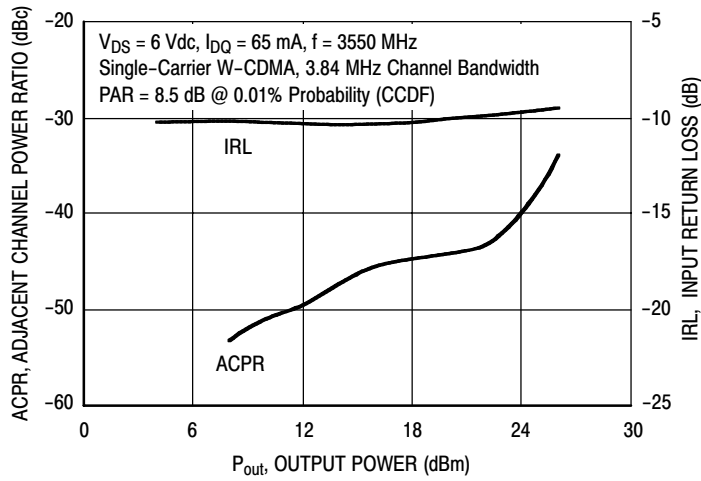
**Figure 4. Single-Carrier W-CDMA ACPR and Input Return Loss versus Output Power**

**NOTE:** All data is referenced to package lead interface.  $\Gamma_S$  and  $\Gamma_L$  are the impedances presented to the DUT. All data is generated from load pull, not from the test circuit shown.

### TYPICAL CHARACTERISTICS



**Figure 5. Single-Carrier W-CDMA Power Gain and Drain Efficiency versus Output Power**



**Figure 6. Single-Carrier W-CDMA ACPR and Input Return Loss versus Output Power**

**NOTE:** Data is generated from the test circuit shown.

**Table 6. Class AB Common Source S-Parameters at  $V_{DS} = 6$  Vdc,  $I_{DQ} = 65$  mA**

f GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠φ	S <sub>21</sub>	∠φ	S <sub>12</sub>	∠φ	S <sub>22</sub>	∠φ
0.50	0.906	-173.61	6.43	84.54	0.0316	1.5	0.713	-174.6
0.55	0.906	-175.37	5.86	82.68	0.0319	0.8	0.714	-175.9
0.60	0.906	-176.93	5.38	80.94	0.0320	-0.6	0.714	-177.3
0.65	0.906	-178.40	4.98	79.21	0.0317	-1.7	0.713	-178.6
0.70	0.908	-179.79	4.65	77.51	0.0320	-2.8	0.713	-179.9
0.75	0.907	179.01	4.34	75.94	0.0320	-3.3	0.712	178.9
0.80	0.907	177.87	4.08	74.33	0.0321	-4.3	0.713	177.6
0.85	0.907	176.78	3.85	72.72	0.0323	-5.5	0.713	176.4
0.90	0.908	175.82	3.65	71.14	0.0324	-6.3	0.713	175.1
0.95	0.908	174.92	3.46	69.56	0.0322	-6.7	0.712	173.7
1.00	0.907	174.04	3.30	68.00	0.0322	-7.7	0.711	172.4
1.05	0.908	173.19	3.15	66.45	0.0324	-8.9	0.712	171.1
1.10	0.909	172.44	3.02	64.84	0.0325	-9.2	0.711	169.7
1.15	0.909	171.49	2.90	63.23	0.0327	-10.6	0.711	168.2
1.20	0.907	170.67	2.79	61.71	0.0327	-11.6	0.711	167.0
1.25	0.907	169.76	2.68	60.14	0.0328	-12.0	0.709	165.7
1.30	0.907	168.81	2.59	58.62	0.0328	-13.3	0.709	164.5
1.35	0.911	167.94	2.50	57.03	0.0330	-14.1	0.713	163.5
1.40	0.904	167.04	2.43	55.47	0.0334	-14.8	0.706	162.3
1.45	0.906	165.86	2.36	53.91	0.0334	-16.2	0.707	161.1
1.50	0.905	164.68	2.30	52.30	0.0333	-16.9	0.707	160.1
1.55	0.907	162.72	2.18	51.28	0.0325	-17.3	0.712	161.0
1.60	0.908	161.85	2.11	49.87	0.0327	-17.9	0.712	160.0
1.65	0.908	160.93	2.06	48.41	0.0328	-18.7	0.713	159.1
1.70	0.908	160.05	2.00	46.98	0.0328	-19.8	0.713	158.1
1.75	0.907	159.11	1.95	45.59	0.0330	-20.1	0.712	157.3
1.80	0.907	158.22	1.90	44.16	0.0330	-20.6	0.713	156.4
1.85	0.907	157.41	1.86	42.77	0.0330	-21.2	0.714	155.6
1.90	0.907	156.52	1.82	41.41	0.0332	-22.4	0.713	154.8
1.95	0.907	155.57	1.78	39.95	0.0332	-22.9	0.713	154.0
2.00	0.906	154.82	1.74	38.64	0.0335	-23.8	0.713	153.4
2.05	0.905	153.97	1.71	37.30	0.0336	-24.5	0.712	152.7
2.10	0.904	153.06	1.67	35.97	0.0339	-25.1	0.712	152.1
2.15	0.905	152.15	1.65	34.63	0.0339	-26.0	0.712	151.5
2.20	0.903	151.26	1.62	33.28	0.0340	-26.8	0.711	150.9
2.25	0.902	150.30	1.59	31.95	0.0341	-27.4	0.709	150.3
2.30	0.901	149.48	1.57	30.67	0.0344	-28.0	0.709	149.7
2.35	0.901	148.64	1.55	29.34	0.0345	-28.5	0.707	149.2
2.40	0.900	147.66	1.53	28.02	0.0348	-29.1	0.705	148.6
2.45	0.899	146.68	1.52	26.72	0.0351	-29.6	0.703	148.0
2.50	0.899	145.77	1.50	25.40	0.0353	-30.6	0.703	147.3
2.55	0.897	144.90	1.49	24.06	0.0356	-31.2	0.699	146.8
2.60	0.896	143.88	1.47	22.69	0.0361	-31.7	0.697	146.2
2.65	0.895	143.15	1.46	21.34	0.0365	-32.5	0.695	145.6
2.70	0.894	142.07	1.45	19.94	0.0370	-33.3	0.692	144.9
2.75	0.893	141.15	1.43	18.49	0.0375	-34.0	0.689	144.2

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**Table 6. Class AB Common Source S-Parameters at  $V_{DS} = 6$  Vdc,  $I_{DQ} = 65$  mA (continued)**

f GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠ φ	S <sub>21</sub>	∠ φ	S <sub>12</sub>	∠ φ	S <sub>22</sub>	∠ φ
2.80	0.890	140.26	1.42	17.14	0.0381	-35.1	0.687	143.5
2.85	0.889	139.29	1.42	15.69	0.0385	-36.3	0.684	142.8
2.90	0.888	138.19	1.41	14.28	0.0386	-37.0	0.682	142.0
2.95	0.887	137.20	1.40	12.80	0.0388	-38.3	0.678	141.2
3.00	0.885	136.18	1.40	11.33	0.0392	-38.9	0.676	140.3
3.05	0.884	135.00	1.39	9.81	0.0394	-39.6	0.671	139.4
3.10	0.883	133.98	1.38	8.29	0.0398	-40.5	0.668	138.4
3.15	0.881	132.89	1.38	6.77	0.0402	-41.3	0.665	137.3
3.20	0.880	131.67	1.37	5.14	0.0407	-42.2	0.662	136.2
3.25	0.879	130.56	1.37	3.56	0.0412	-42.9	0.658	135.1
3.30	0.878	129.47	1.36	1.92	0.0415	-44.0	0.656	133.9
3.35	0.876	128.25	1.36	0.22	0.0419	-45.1	0.651	132.8
3.40	0.876	127.01	1.35	-1.44	0.0422	-46.2	0.648	131.5
3.45	0.874	125.80	1.35	-3.12	0.0428	-47.2	0.646	130.2
3.50	0.872	124.44	1.35	-4.89	0.0431	-48.0	0.642	129.0
3.55	0.871	123.10	1.34	-6.62	0.0438	-49.1	0.638	127.5
3.60	0.871	121.58	1.34	-8.32	0.0442	-50.2	0.637	126.0
3.65	0.867	120.32	1.33	-10.12	0.0449	-51.3	0.633	124.9
3.70	0.867	118.80	1.33	-11.94	0.0455	-53.0	0.629	123.5
3.75	0.865	117.37	1.33	-13.68	0.0458	-54.1	0.626	122.0
3.80	0.864	115.86	1.32	-15.54	0.0458	-55.7	0.624	120.5
3.85	0.863	114.26	1.32	-17.42	0.0460	-56.6	0.620	119.1
3.90	0.861	112.73	1.31	-19.27	0.0464	-58.1	0.617	117.6
3.95	0.859	111.11	1.31	-21.16	0.0469	-59.2	0.615	116.1
4.00	0.859	109.30	1.31	-23.12	0.0472	-60.4	0.611	114.7
4.05	0.858	107.69	1.30	-25.03	0.0476	-61.5	0.608	113.2
4.10	0.855	106.01	1.30	-26.95	0.0482	-62.6	0.605	111.8
4.15	0.854	104.09	1.30	-28.98	0.0488	-64.0	0.602	110.3
4.20	0.852	102.36	1.30	-30.89	0.0491	-65.7	0.599	108.8
4.25	0.850	100.53	1.29	-32.85	0.0498	-67.1	0.596	107.4
4.30	0.851	98.59	1.29	-34.85	0.0500	-68.5	0.593	106.0
4.35	0.848	96.65	1.29	-36.86	0.0504	-70.2	0.589	104.4
4.40	0.847	94.71	1.29	-38.87	0.0509	-71.6	0.586	102.9
4.45	0.846	92.56	1.29	-40.97	0.0515	-73.3	0.583	101.4
4.50	0.845	90.47	1.29	-43.11	0.0519	-74.6	0.580	99.8
4.55	0.843	88.43	1.29	-45.16	0.0526	-76.2	0.576	98.2
4.60	0.840	86.15	1.29	-47.39	0.0531	-77.8	0.572	96.5
4.65	0.839	83.96	1.29	-49.59	0.0537	-79.6	0.568	94.8
4.70	0.837	81.79	1.29	-51.81	0.0541	-81.3	0.564	93.0
4.75	0.835	79.39	1.30	-54.06	0.0546	-83.0	0.559	91.2
4.80	0.834	77.08	1.30	-56.36	0.0550	-85.0	0.556	89.4
4.85	0.832	74.81	1.30	-58.58	0.0554	-86.6	0.550	87.6
4.90	0.831	72.32	1.30	-60.91	0.0560	-88.1	0.546	85.5
4.95	0.831	69.82	1.31	-63.36	0.0565	-90.0	0.542	83.6
5.00	0.829	67.43	1.31	-65.78	0.0571	-91.8	0.537	81.5
5.05	0.826	64.82	1.31	-68.28	0.0578	-93.5	0.532	79.2

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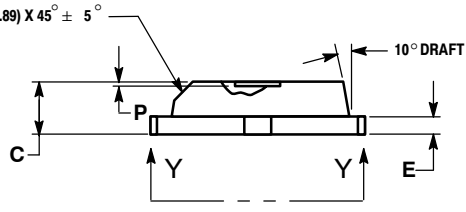
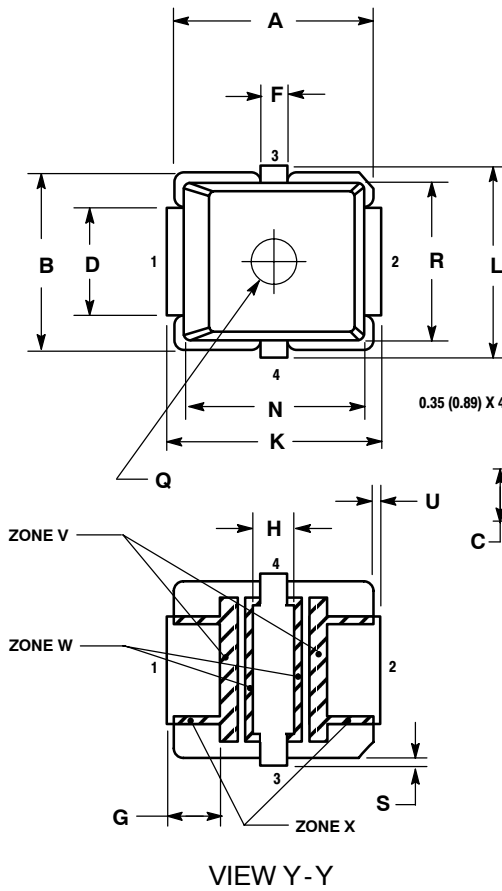
**Table 6. Class AB Common Source S-Parameters at  $V_{DS} = 6$  Vdc,  $I_{DQ} = 65$  mA (continued)**

f GHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	S <sub>11</sub>	∠φ	S <sub>21</sub>	∠φ	S <sub>12</sub>	∠φ	S <sub>22</sub>	∠φ
5.10	0.826	62.21	1.31	-70.79	0.0583	-95.6	0.528	77.0
5.15	0.824	59.75	1.31	-73.33	0.0592	-97.5	0.524	74.7
5.20	0.821	57.08	1.31	-75.85	0.0596	-99.5	0.519	72.3
5.25	0.819	54.50	1.31	-78.30	0.0605	-101.5	0.516	70.0
5.30	0.818	51.91	1.32	-80.93	0.0610	-103.7	0.512	67.4
5.35	0.815	49.24	1.32	-83.65	0.0617	-105.8	0.510	64.6
5.40	0.814	46.40	1.32	-86.36	0.0626	-108.2	0.506	61.9
5.45	0.812	43.69	1.32	-89.16	0.0629	-110.5	0.501	59.0

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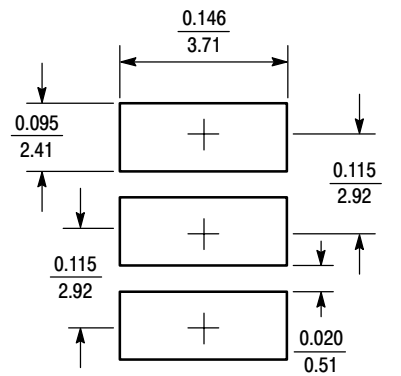
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### PACKAGE DIMENSIONS



- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1984.
  2. CONTROLLING DIMENSION: INCH
  3. RESIN BLEED/FLASH ALLOWABLE IN ZONE V, W, AND X.
- STYLE 1:  
 PIN 1. DRAIN  
 2. GATE  
 3. SOURCE  
 4. SOURCE

**CASE 466-03  
 ISSUE D  
 PLD-1.5  
 PLASTIC**



(inches / mm)

### SOLDER FOOTPRINT

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.255	0.265	6.48	6.73
B	0.225	0.235	5.72	5.97
C	0.065	0.072	1.65	1.83
D	0.130	0.150	3.30	3.81
E	0.021	0.026	0.53	0.66
F	0.026	0.044	0.66	1.12
G	0.050	0.070	1.27	1.78
H	0.045	0.063	1.14	1.60
J	0.160	0.180	4.06	4.57
K	0.273	0.285	6.93	7.24
L	0.245	0.255	6.22	6.48
N	0.230	0.240	5.84	6.10
P	0.000	0.008	0.00	0.20
Q	0.055	0.063	1.40	1.60
R	0.200	0.210	5.08	5.33
S	0.006	0.012	0.15	0.31
U	0.006	0.012	0.15	0.31
ZONE V	0.000	0.021	0.00	0.53
ZONE W	0.000	0.010	0.00	0.25
ZONE X	0.000	0.010	0.00	0.25

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## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

### Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

## REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
2	Jan. 2008	<ul style="list-style-type: none"> <li>• Listed replacement part, p. 1</li> <li>• Added Product Documentation and Revision History, p. 11</li> </ul>

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